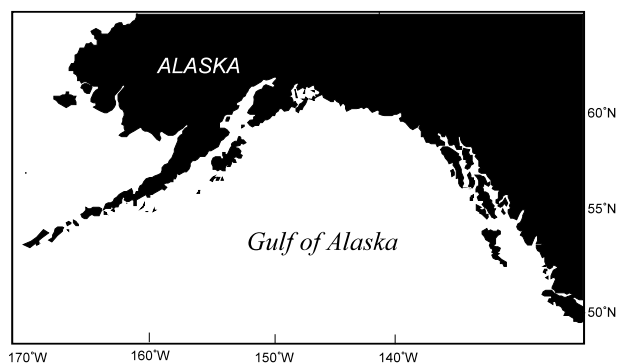


APPENDIX B

STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE GULF OF ALASKA

Compiled by

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November 2001

**North Pacific Fishery Management Council
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**Stock Assessment and Fishery Evaluation Report
for the Groundfish Resources
of the Gulf of Alaska
as Projected for 2002**

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SUMMARY

by

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska

INTRODUCTION

The *National Standard Guidelines for Fishery Management Plans* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management. The FMPs for the groundfish fisheries managed by the Council require that drafts of the SAFE reports be produced each year in time for the October and December North Pacific Fishery Management Council (Council) meetings.

The SAFE report for the Gulf of Alaska (GOA) groundfish fisheries is compiled by the Plan Team for the Gulf of Alaska Groundfish FMP from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G). The stock assessment section includes recommended acceptable biological catch (ABC) levels for each stock and stock complex managed under the FMP. The ABC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other management strategies for the fisheries.

The GOA Groundfish Plan Team met in Seattle on November 13-16, 2001 to review the status of stocks of sixteen species or species groups that are managed under the FMP. The Plan Team review was based on presentations by ADF&G and NMFS AFSC scientists, and data from the 2001 GOA biennial trawl survey and the 2001 sablefish longline survey. Members of the Plan Team who compiled the SAFE report were Sandra Lowe, (chair), Jane DiCosimo (plan coordinator), Jeff Fujioka, Jon Heifetz, Jim Ianelli, Kathy Kuletz, Victoria O'Connell, Tom Pearson, Beth Sinclair, Farron Wallace, and Gregg Williams.

The GOA FMP recognizes single species and species complex management strategies. Single species management is recommended for stocks that are easily targeted by the harvesting sector and for which minimal mixing of other species occurs in the targeted catch. In the Gulf of Alaska, Pacific cod, pollock, sablefish, Pacific ocean perch, thornyhead rockfish, flathead sole, rex sole, arrowtooth flounder, northern rockfish, and Atka mackerel are managed as single species. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, shortraker and rougheye rockfish, other slope rockfish, pelagic shelf rockfish, demersal shelf rockfish, deepwater flatfish, shallow water flatfish, and "other species" have been managed within complexes.

Fishermen do not catch species in a complex in proportion to the species composition, i.e., certain segments of the complex may be more easily harvested than others, or they may be more valuable. Consequently, the implicit risk in species complex management is that one or more of the species in the complex may be overharvested or underharvested. Recognition of this risk is important. Alternative management strategies can be imposed to limit this risk, including removing a species from a complex and managing as a single species, or reducing the quota of the complex to protect the more vulnerable species. The Plan Team gave close scrutiny to the species composition of the catch from the species complex management units and made recommendations for adjustments as required.

The FMP authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP. Atka mackerel was split out from "other species" beginning in 1994.

In 1998, black and blue rockfish were removed from the GOA FMP and management was deferred to ADF&G. Beginning in 1999, osmerids (eulachon, capelin and other smelts) were removed from the “other species” category and placed in a separate forage fish category, along with other species found to be primary food sources for other marine animals. As part of that same action, directed commercial fisheries on species in this category were prohibited. This year, the Plan Team recommends apportioning the “other species” TAC to its individual components (sharks, skates, squid, octopus and sculpins) based on the 1999 draft other species stock assessment. The Team further recommends moving to individual stock assessments in the near future and will submit a groundfish proposed to that effect in the next call for proposals.

Groundfish catches are managed against TAC specifications for EEZ and near coastal waters of the GOA. State of Alaska internal water groundfish populations are not surveyed by NMFS and catches from internal water fisheries should not be counted against the TAC. The Team has recommended that these catches represent unassessed fish, and should not be counted against an ABC or TAC. The Team noted that internal water bycatches of shortraker/rougheye rockfish in Chatham Strait are counted against the Federal TAC and that this practice should not continue. The pollock assessment incorporated the ADF&G survey pollock biomass for 2001. The Plan Team acknowledged that it was appropriate to reduce the Western (W), Central (C) and West Yakutat (WY) combined GOA pollock ABC by the anticipated Prince William Sound (PWS) harvest level for the State fishery. The pollock assessment did not incorporate the ADF&G data for 2002 because the data was not received in time to do so. However, since the Team intends to annually include the State data and deduct the accompanying GHL, the Team deducted the 2002 PWS GHL of 1,700 mt from the W/C/WY pollock ABC before area apportionments were made.

The 2001 Gulf of Alaska bottom trawl survey did not sample the Eastern Gulf of Alaska management area (Areas 640 and 650). Each stock assessment estimated biomass from the eastern area based on one of the following approaches; past survey data was used to decide which of the two approaches was most appropriate for a given species:

- (1) Assume that year-to-year changes in eastern gulf biomass are related to changes in the central gulf. Multiply the 2001 survey estimate of biomass in the central gulf by the ratio of eastern/central biomass from past data to generate an estimate of 2001 biomass for the eastern region.
- (2) Assume that, because of distribution or habitat differences, the species of interest has an eastern region biomass that is independent of trends in the central gulf. In this case the most logical estimator of eastern biomass is some average of eastern region biomass from earlier surveys.

The Plan Team has provided EGOA subarea ABC recommendations on a case by case basis based on the following rationale since 1998. The Plan Team recommended splitting the EGOA ABC for species/complexes that would be disproportionately harvested from the West Yakutat area by trawl gear. The Team did not split EGOA ABCs for species that were prosecuted by multi-gear fisheries or harvested as bycatch. For those species where a subarea ABC split was deemed appropriate, two approaches were examined. The point estimate for WY biomass distribution based on survey results was recommended for seven species/complexes to determine the WY and East Yakutat/Southeast Outside subarea ABC splits. For three species/complexes, a range was recommended bounded by the point estimate and the upper end of the 95% confidence limit from all three surveys. The rationale for providing a range was based on a desire to incorporate the variance surrounding the distribution of biomass for those species/complexes that could potentially be constrained by the recommended ABC splits. The Team continues to support this rationale for determining 2002 ABCs. The Team presents both the point estimate and the upper 95% confidence limit, but based its 2002 recommendations on the upper 95% confidence limit.

NO SPLIT	SPLIT, POINT ESTIMATE	SPLIT, UPPER 95% CL
Pacific cod	Deepwater flatfish	Pacific ocean perch
Atka mackerel	Shallowwater flatfish	Pelagic shelf rockfish
Shortraker/rougheye	Rex sole	
Thornyhead	Sablefish	
Northern rockfish	Arrowtooth flounder	
Demersal shelf rockfish	Flathead sole	
	Other slope rockfish	
	Pollock	

While ecosystem considerations are noted by the authors and Plan Team to accompany their recommendations of OFLs and ABCs, the stock assessments are based on a single stock or stock complex. An ecosystem chapter that annually collects summaries of ecosystem-related topics was initiated in 1995. Ecosystem concerns that were identified by the Team were moved from this summary section to the Ecosystem Considerations chapter (bound separately). NMFS Alaska Fisheries Science Center staff are developing a template for evaluating ecosystem indicators in relation to the recommended specifications, that will be incorporated into the Ecosystem Considerations Chapter next year.

Since the Stock Assessment and Fishery Evaluation Report (SAFE) for 2001 was issued (NPFMC 1999), the following new information has been incorporated in the stock assessments:

- (1) Pollock: a) 2000 catch at age; b) 2000 age composition and 2001 biomass and age composition from the Shelikof Strait EIT survey; c) 2001 biomass and length composition from the NMFS bottom trawl survey; d) 2000 age composition, 2001 biomass and length composition from the ADF&G crab/groundfish trawl survey; e) estimates of pollock biomass during 1961-82 from a GLM model using historical 400-mesh eastern trawl survey data.
- (2) Pacific cod: a) Size composition data from the 2000 and January-August 2001 commercial fisheries were incorporated into the model; b) size composition data from the 2001 GOA bottom trawl survey were incorporated; c) the biomass estimate from the 2001 GOA bottom trawl survey.
- (3) Flatfish: Biomass estimates from the 2001 GOA bottom trawl survey.
- (4) Arrowtooth: Biomass estimate from the 2001 GOA bottom trawl survey.
- (5) Sablefish: a) Relative abundance and length data from the 2001 longline survey; b) relative abundance and length data from the 2000 longline fishery; c) age data from the 2000 longline survey and longline fishery; d) and ages from the 1985 longline survey.
- (6) Slope Rockfish: Biomass estimates from the 2001 GOA bottom trawl survey.
- (7) Pelagic shelf rockfish: a) Biomass estimates from the 2001 GOA bottom trawl survey; b) computations of ABC and overfishing were done separately for dusky rockfish versus widow and yellowtail rockfish; c) updated commercial and survey catch tables; d) three new items of data for dusky rockfish: length frequency distributions for the 2000 commercial fishery; size compositions from the 2001 trawl survey; and age compositions from the 1999 trawl survey.

- (8) Demersal shelf rockfish: a) new density data from the NSEO management area; b) yelloweye average weight and standard error data were updated; c) new age data from the 2000 fishery are included; and d) updated discussion of halibut bycatch.
- (9) Thornyheads: a) 1999-2000 harvest levels by gear, biomass estimates from the 2001 trawl survey; and b) relative population numbers from the 2001 sablefish longline survey.
- (10) Atka mackerel: Length frequency data from the 2001 GOA bottom trawl survey.
- (11) Groundfish, generally: Updated harvest and discard data from the NMFS Observer Program and Regional Office for 2001.

BACKGROUND INFORMATION

Management Areas and Species

The Gulf of Alaska (GOA) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Figure 1). Five categories of finfishes and invertebrates have been designated for management purposes. They are, target species, other species, prohibited species, forage fish species and non-specified species. This SAFE report describes stock status of target species only. Species or complexes included in each of the first three categories are listed below.

<u>Target Species</u>	<u>Other Species</u>	<u>Prohibited Species</u>
Pollock	Octopus	Pacific halibut
Pacific cod	Squid	Pacific herring
Flounders	Sculpins	Pacific salmon
Rockfishes	Sharks	Steelhead trout
Sablefish	Skates	King crab
Atka mackerel		Tanner crab

No specifications are set for forage fish and catch records need not be kept. All other species of fish and invertebrates taken incidentally that are not managed by other FMPs and are associated with groundfish fisheries are designated as “non-specified species.” No specifications are set and catch records need not be kept. A species or species group from within the target species category may be split out and assigned an appropriate harvest level. Similarly, species in the target species category may be combined and a single harvest level assigned to the new aggregate species group. The harvest level for demersal shelf rockfish in the Eastern Regulatory Area is specified by the Council each year. However, management of this fishery is deferred to the State of Alaska with Council oversight.

Biological Reference Points

A number of biological reference points are used in this SAFE. Among these are the fishing mortality rate (F) and stock biomass level (B) associated with MSY (F_{MSY} and B_{MSY} , respectively). Fishing mortality rates reduce the level of spawning biomass per recruit to some percentage P of the pristine level ($F_{P\%}$). Fishing mortality rate reduces the slope of the yield per recruit curve (plotted against F) to 10% of the slope at the origin ($F_{0.1}$). The fishing mortality rate used to compute ABC is designated F_{ABC} , and the fishing mortality rate used to compute the overfishing level (OFL) is designated F_{OFL} .

Definition of Acceptable Biological Catch and the Overfishing Level

Amendment 56 to the BSAI Groundfish FMP, approved by the Council in June 1998, defines ABC and OFL for the BSAI groundfish fisheries. The new definitions are shown below, where the fishing mortality rate is denoted F , stock biomass (or spawning stock biomass, as appropriate) is denoted B , and the F and B levels corresponding to MSY are denoted F_{MSY} and B_{MSY} respectively.

Acceptable Biological Catch is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under “overfishing” below.

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is reliable for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a pdf refers to a probability density function. For tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient a is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form " $F_{X\%}$ " refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F = F_{40\%}$.

- Tier 1) *Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY} .*
- 1a) *Stock status: $B/B_{MSY} > 1$*
 $F_{OFL} = m_A$, the arithmetic mean of the pdf
 $F_{ABC} \leq m_H$, the harmonic mean of the pdf
- 1b) *Stock status: $a < B/B_{MSY} \leq 1$*
 $F_{OFL} = m_A \times (B/B_{MSY} - a)/(1 - a)$
 $F_{ABC} \leq m_H \times (B/B_{MSY} - a)/(1 - a)$
- 1c) *Stock status: $B/B_{MSY} \leq a$*
 $F_{OFL} = 0$
 $F_{ABC} = 0$
- 2) *Information available: Reliable point estimates of B , B_{MSY} , F_{MSY} , $F_{35\%}$, and $F_{40\%}$.*
- 2a) *Stock status: $B/B_{MSY} > 1$*
 $F_{OFL} = F_{MSY}$
 $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$
- 2b) *Stock status: $a < B/B_{MSY} \leq 1$*
 $F_{OFL} = F_{MSY} \times (B/B_{MSY} - a)/(1 - a)$
 $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - a)/(1 - a)$
- 2c) *Stock status: $B/B_{MSY} \leq a$*
 $F_{OFL} = 0$
 $F_{ABC} = 0$

- 3) *Information available: Reliable point estimates of B , $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.*
- 3a) *Stock status: $B/B_{40\%} > 1$*

$$F_{OFL} = F_{35\%}$$

$$F_{ABC} \leq F_{40\%}$$
- 3b) *Stock status: $a < B/B_{40\%} \leq 1$*

$$F_{OFL} = F_{35\%} \times (B/B_{40\%} - a)/(1 - a)$$

$$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - a)/(1 - a)$$
- 3c) *Stock status: $B/B_{40\%} \leq a$*

$$F_{OFL} = 0$$

$$F_{ABC} = 0$$
- 4) *Information available: Reliable point estimates of B , $F_{35\%}$, and $F_{40\%}$.*

$$F_{OFL} = F_{35\%}$$

$$F_{ABC} \leq F_{40\%}$$
- 5) *Information available: Reliable point estimates of B and natural mortality rate M .*

$$F_{OFL} = M$$

$$F_{ABC} \leq 0.75 \times M$$
- 6) *Information available: Reliable catch history from 1978 through 1995.*

$$OFL = \text{the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information}$$

$$ABC \leq 0.75 \times OFL$$

OVERVIEW OF STOCK ASSESSMENTS

The current status of individual groundfish stocks managed under the FMP are summarized in this section. The abundances of Pacific ocean perch, northern rockfish, thornyhead, and arrowtooth flounder are above target stock size. The abundances of pollock, Pacific cod, and sablefish are below target stock size. The relative abundances of deep-water flatfish, shallow-water flatfish, flathead sole, demersal shelf rockfish, pelagic shelf rockfish, other slope rockfish, and Atka mackerel are unknown.

Tables 1 and 2 provide a summary of the current status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2001, and recommendations for ABCs and overfishing levels (OFLs) for 2002. Fishing mortality rates (F) and OFLs used to set these specifications are listed in Table 3. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 4 provides a list of species for which the ABC recommendations are below the maximum permissible. Table 5 provides historical groundfish catches in the GOA, 1956-2001.

The sum of the preliminary 2002 ABCs for target species is 394,780 mt, which is within the FMP-approved optimum yield (OY) of 116,000 - 800,000 mt for the Gulf of Alaska. The sum of 2002 OFLs is 509,450 mt. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2002 will be considerably under this upper limit. For perspective, the sum of the 2001 TACs was 285,994 mt, and the sum of the ABCs was 447,710 mt.

The following conventions in this SAFE are used:

- (1) “Fishing mortality rate” refers to the full-selection F (i.e., the rate that applies to fish of fully selected sizes or ages). A full-selection F should be interpreted in the context of the selectivity schedule to which it applies.
- (2) For consistency and comparability, “exploitable biomass” refers to projected age+ biomass, which is the total biomass of all cohorts greater than or equal to some minimum age. The minimum age varies from species to species and generally corresponds to the age of recruitment listed in the stock assessment. Trawl survey data may be used as a proxy for age+ biomass. The minimum age (or size), and the source of the exploitable biomass values are defined in the summaries. These values of exploitable biomass may differ from listed in the corresponding stock assessments if the technical definition is used (which requires multiplying biomass at age by selectivity at age and summing over all ages). In those models assuming knife-edge recruitment, age+ biomass and the technical definitions of exploitable biomass are equivalent.
- (3) The values listed as 2000 and 2001 ABCs correspond to the values (in mt) approved by NMFS; some Council recommendations for 2001 were modified in the final rule for Steller sea lion reasonable and prudent alternatives. The values listed for 2002 correspond to the Plan Team recommendations.
- (4) The exploitable biomass for 2000 and 2001 that are reported in the following summaries were estimated by the assessment in those years. Comparisons of the 2002 biomass with previous years’ levels should be made with biomass levels from the revised hindcast reported in each assessment.

POLLOCK

	ABC	EXPLOITABLE ¹			
	W/C/WYK	EYK/SEO	TOTAL	BIOMASS	CATCH
2000	93,540	6,460	100,000	588,000	73,080
2001	99,350	6,460	105,810	699,000	70,416 ²
2002	51,790 ³	6,460	58,250	726,600	

¹ Age 3+ biomass.

² Catch through November 15, 2001.

³ The 2002 ABC is reduced by 1,700 mt to accommodate the Prince William Sound GHL.

The age-structured assessment model developed using ADModel Builder (a C++ software language extension and automatic differentiation library) used for assessments in 1999 and 2000 is basically unchanged. Model exploration focused on approaches to incorporating trawl survey data prior to 1984 and modeling information from a comparative trawling experiment between an ADFG 400-mesh eastern trawl and a NMFS poly-Nor' eastern trawl.

Three surveys conducted in 2001 all had lower estimates of pollock biomass relative to previous surveys: 1) the 2001 NMFS summer bottom trawl survey showed a 65% decline in biomass from the 1999 survey; 2) the 2001 Shelikof Strait EIT survey showed a 49% decline in spawning adults from the 2000 survey; and 3) the 2001 ADF&G crab/groundfish pollock biomass estimate declined by only about 15% from the 2000 survey.

In contrast to the low estimates of adult biomass, both the Shelikof Strait EIT survey and the NMFS summer bottom trawl survey found record numbers of juvenile pollock. The Shelikof Strait EIT survey estimate of age-2 fish was the highest on record, and the NMFS bottom trawl estimate of age-1 fish was the highest on record. If these year classes (1999 and 2000) prove to be as abundant as initial estimates, increases in pollock biomass can be anticipated. However, the Plan Team agrees with the assessment authors that it is still too early to determine the strength of these year classes.

A GLM analysis of historical trawl survey data (1961-82) produced indices of pollock abundance prior to the start of the NMFS triennial survey in 1984. Incorporation of these indices and information from a comparative trawling experiment made it possible to extend the time series of pollock biomass and recruitment back to 1961. Model results suggest that population biomass in 1961, prior to large-scale commercial exploitation of the stock, may have been the lowest observed. Major increases in pollock abundance occurred just prior to the 1977 regime shift.

The model estimated spawning biomass in 2002 to be 158,300 mt, a decrease of 22% from last year's estimate for 2001, and a decrease of 8% from last year's projection for 2002. Spawning biomass in 2002 is estimated to be 26% of unfished. Lower model estimates of biomass in 2002 are primarily due to lower than expected biomass from the 2001 NMFS trawl survey and low abundance of spawning adults in the 2001 Shelikof Strait EIT survey. The $B_{40\%}$ estimate of 245,000 mt is similar to the estimate of 250,000 mt in the 2000 assessment. Gulf pollock are in Tier 3b. The projected 2002 age biomass estimate is 726,600 mt. A large part of this increase in 3+ biomass is due to the current estimate of the 1999 year class.

As consequence of lower survey biomass estimates, the estimated fishing mortality in 2001 will be higher than anticipated. Had the entire 2001 ABC been taken, the overfishing limit as estimated in 2001 for pollock would have been exceeded. As it happened, the projected catch for 2001 will be substantially below the 2001 ABC. The assessment authors expressed concern that the maximum permissible ABC might not provide a sufficient buffer between ABC and OFL when the stock is below $B_{40\%}$. This led to a more conservative ABC

recommendation (based on reductions to the maximum permissible ABC) to maintain the same buffer between ABC and OFL at low biomass as at high biomass.

The Plan Team notes that given perfect information, the maximum permissible ABC under Tier 3b (adjusted $F_{40\%}$ strategy) would be appropriate. We agree with the authors that a downward adjustment to the maximum permissible ABC is warranted because of assessment uncertainty, and support the stock assessment authors' ABC recommendation. The Team acknowledges the merit in the proposed harvest strategy for pollock which maintains a constant buffer between ABC and OFL over all biomass levels. However, we would like further information to evaluate whether the reduction in the OFL control rule as biomass declines is appropriate, and what level of risk is being assumed at lower biomass levels. We would like to see further analysis of this strategy in a broader context when the ABC/OFL definitions are reconsidered, including applications to other species.

The 2002 ABC recommendation for pollock in the Gulf of Alaska west of 140° W long. is 53,490 mt ($F_{ABC} = 0.17$), a decrease of 34% from the last year's projected maximum permissible ABC for 2002. The recommendation is lower in part because of lower than projected biomass (21%), and in part because of a more conservative ABC recommendation (13%). The 2002 overfishing level is 75,480 mt ($F_{OFL} = 0.24$). The 2002 recommended ABC for the Western, Central and West Yakutat area is reduced to accommodate the 2002 Prince William Sound Groundfish Harvest Level (1,700 mt) resulting in an ABC of 51,790 mt.

Due to the lack of new survey data in the EGOA, the 2002 ABC recommendation for pollock in southeast Alaska (East Yakutat and Southeastern areas) is unchanged at 6,460 mt. The 2002 southeast OFL is also unchanged at 8,610 mt.

The 2001 RPAs require apportionment of pollock among Gulf of Alaska management areas based on the seasonal distribution of biomass. The assessment used available data from a composite of winter surveys to apportion pollock in the A and B seasons and the summer bottom trawl surveys to apportion pollock in the C and D seasons. The Plan Team concurs with this approach, but recommends further survey work to better determine the winter biomass distributions. The recommended apportionment of the 2002 ABC of 51,790 mt assuming an initial allocation of 25% to each season, is:

Area					
Season	Shumagin (610)	Chirikof (620)	Kodiak (630)	West Yakutat (640)	Total
A	2,916	8,618	1,122	292	12,948
B	2,916	8,618	1,122	291	12,948
C	5,949	2,905	3,803	291	12,948
D	5,949	2,904	3,803	291	12,947
Total	17,730	23,045	9,850	1,165	51,790

PACIFIC COD

YEAR	EXPLOITABLE		CATCH ³
	ABC ¹	BIOMASS ²	
2000	76,400	567,000	54,528
2001	67,800	468,000	41,085 ³
2002	57,600	428,000	

¹ Includes State management fisheries.

² Age 3+ biomass

³ Catch through November 15, 2001.

Size composition data from the 2000 and January-August 2001 commercial fisheries were incorporated into the model as well as size composition data and biomass data from the 2001 GOA bottom trawl survey. The Eastern area was not surveyed in 2001, therefore it was necessary to use the 1999 Eastern area survey value to provide a Gulf-wide value (the 2001 estimate of 256,025 mt, for the Western and Central areas only, was down about 10% from the 1999 estimate for the same two areas).

The Bayesian meta-analysis which has formed the basis for a risk-averse ABC recommendation in the 1996-1999 assessments was not performed for the present assessment. Similar to last year's approach, the ratio between the recommended F_{ABC} and $F_{40\%}$ estimate given in the 1999 assessment (0.87) was assumed to be an appropriate factor by which to multiply the 2002 maximum permissible F_{ABC} to obtain a recommended 2002 F_{ABC} .

The estimated 2002 spawning biomass for the GOA stock is 82,000 mt, down about 13% from last year's estimate and down about 2% from last year's F_{ABC} projection for 2002. The $B_{40\%}$ reference level is 85,000 mt, thus Pacific cod are in Tier 3b. The estimated 2002 total age 3+ biomass for the GOA stock is 428,000 mt, down about 9% from last year's estimate for 2001 and down about 3% from last year's $F_{40\%}$ projection for 2002.

The Plan Team concurs with the author's recommended 2002 ABC for the GOA stock of 57,600 mt, which is down about 15% from last year's recommendation for 2001 and up about 3% from last year's F_{ABC} projection for 2002. The estimated 2002 OFL for the GOA stock is 77,100 mt, down about 15% from last year's estimate for 2001.

Apportionment of Pacific cod by area has been based on the most recent survey results which have been relatively consistent from survey to survey, with 36%, 57%, and 7% in the Western, Central, and Eastern areas, respectively in the 1999 survey. In the 2001 survey the apportionment changed somewhat with 47%, 45%, and 8% in the Western, Central, and Eastern areas respectively. Pacific cod are believed to move sufficiently from area to area, such that any harvest apportionment within the range of the 1999 or 2001 survey results as needed to address other concerns would be biologically acceptable to Pacific cod.

Area apportionment alternatives (mt)

Based on	Western	Central	Eastern
2001 Survey	27,070	25,920	4,610
1999 Survey	20,735	32,830	4,030
1996, 1999, 2001 average	22,465	31,680	3,455

FLATFISH

<u>2000</u>	<u>ABC</u>	EXPLOITABLE <u>BIOMASS</u>	<u>CATCH</u>
Deep water	5,300	74,460	892
Rex sole	9,440	74,600	3,352
Shallow water	37,860	299,100	6,185
Flathead sole	<u>26,270</u>	<u>207,520</u>	<u>1,445</u>
TOTAL	78,870	655,680	12,398

<u>2001</u>	<u>ABC</u>	EXPLOITABLE <u>BIOMASS</u>	<u>CATCH</u> ¹
Deep water	5,300	74,460	805
Rex sole	9,440	74,600	2,939
Shallow water	37,860	299,100	6,173
Flathead sole	<u>26,270</u>	<u>207,520</u>	<u>1,910</u>
TOTAL	78,870	655,680	11,827

<u>2002</u>	<u>ABC</u>	EXPLOITABLE <u>BIOMASS</u>
Deep water	4,880	68,263
Rex sole	9,470	71,326
Shallow water	49,550	349,992
Flathead sole	<u>22,690</u>	<u>170,915</u>
TOTAL	86,590	660,496

¹ Catch through November 15, 2001.

The flatfish group is subdivided into deep water flatfish, rex sole, shallow water flatfish, and flathead sole. The 2002 exploitable biomass for each group is based on results from the 2001 NMFS triennial trawl survey. However, the lack of survey effort in 2001 in the eastern GOA resulted in biomass in the eastern GOA being approximated by using the average of the 1993-1999 eastern GOA biomass estimates. In addition, biomass estimates for some species were also affected by the lack of sampling deeper than 500 m. The 500—1,000 m depth strata not sampled in 2001 is generally outside the depth range of most flatfish species, with the exception of Dover sole, Greenland turbot, deep-sea sole and, to a lesser extent, rex sole.

ABC and OFL were calculated by species, with individual species identified as tier 4, 5, or 6 depending upon the available data. The total flatfish ABC for 2002 increased almost 10 percent from 2001, driven primarily by an increase in the ABCs for rock sole and starry flounder in the shallow water group. Individually, the deep water flatfish group ABC declined from 5,300 mt in 2001 to 4,880 mt in 2002 and the flathead sole ABC declined from 26,270 mt to 22,690 mt. The , the rex sole ABC increased from 9,440 mt to 9,470 mt and the shallow water flatfish ABC increased from 37,860 mt to 49,550 mt. Apportioning ABCs among the regulatory areas in proportion to biomass distributions in the 2001 trawl survey results in the area apportionments listed below. As in 2000, the Team recommends splitting the eastern GOA ABC between the WY and EYAK/SEO subareas. The resulting 2002 ABCs are:

	<u>WESTERN</u>	<u>CENTRAL</u>	<u>WYAK</u>	<u>EYAK/SEO</u>	<u>TOTAL</u>
Deep water	180	2,220	1,330	1,150	4,880
Rex sole	1,280	5,540	1,600	1,050	9,470
Shallow water	23,550	23,080	1,180	1,740	49,550
Flathead sole	9,000	11,410	1,590	690	22,690

The overfishing levels for the flatfish groups are determined by the fishing mortality rates determined from the tier structure of the exploitable biomass estimates. Those fishing mortality rates and associated catch levels are:

	<u>OVERFISHING</u>			
	<u>E_{ABC}</u>	<u>E_{OFL}</u>	<u>LEVEL</u>	<u>TIER</u>
Deep water	0.075	0.10	6,430	5,6
Rex sole	0.15	0.20	12,320	5
Shallow water	0.15-0.17	0.2-.21	61,810	4,5
Flathead sole	0.15	0.20	29,530	5

ARROWTOOTH FLOUNDER

<u>YEAR</u>	<u>ABC</u>	<u>EXPLOITABLE BIOMASS</u>	<u>CATCH¹</u>
2000	145,360	1,571,670	24,056
2001	148,150	1,586,530	19,909
2002	146,260	1,760,000	

¹ Catch through November 15, 2001.

The 2002 exploitable biomass of 1,760,000 mt is based on abundance estimates derived from an age-structured model developed with AD Model Builder software. Similar to the previous assessment, the model accommodated a higher proportion of females in the larger size intervals of both survey and fishery data by giving males a higher mortality rate than females. One change from last year's assessment was the removal of the weighting factors used on the survey inputs to the model. Because the NMFS trawl survey did not cover the eastern GOA, the 1993-1999 average biomass was used to estimate the EGOA biomass. Female spawning biomass in 2002 is estimated to be greater than $B_{40\%}$ and ABC was determined to be 146,264 mt, based on Tier 3a calculations ($F_{40\%} = 0.134$). The overfishing level was determined to be 171,060 mt ($F_{35\%} = 0.16$). The Team recommended that ABC be apportioned among regulatory areas in proportion to biomass distributions in the 2001 trawl survey. The resulting ABCs are:

<u>WESTERN</u>	<u>CENTRAL</u>	<u>WYAK</u>	<u>EYAK/SEO</u>	<u>TOTAL</u>
16,960	106,580	17,150	5,570	146,260

SABLEFISH

<u>YEAR</u>	<u>EXPLOITABLE</u>		
	<u>ABC</u>	<u>BIOMASS</u> ¹	<u>CATCH</u> ¹
2000	13,300	169,000	12,227
2001	12,840	188,000	12,047
2002	12,820	188,000	

¹ Catch through November 15, 2001.

The sablefish survey abundance index increased 16% in numbers and 13% in weight from 2000 to 2001. These increases follow decreases from 1999 to 2000 in the survey abundance index of 10% in numbers and 8% in weight and in the fishery abundance index of 5% in weight, so that relative abundance in 2001 is slightly higher than 1999. Fishery abundance data for 2001 were not analyzed because the fishery remains open. Exploitable and spawning biomass are projected to increase 4 and 2%, respectively, from 2001 to 2002. Alaska sablefish abundance now appears low and slowly increasing. The slow increase confirms the projection from last year's assessment that the abundance will increase slowly due to the above average 1995 and 1997 year classes; the size of the increase depends on the actual strength of the 1997 and another year class that likely is above average, the 1998 year class. Spawning biomass is projected to increase to 35% of unfished biomass in 2002, having been as low as 33% of unfished spawning biomass during 1998 to 2000.

A simple decision analysis was completed to determine what catch levels will result in stable or increasing spawning biomass. The decision analysis indicates that a yield of 17,300 mt will maintain spawning biomass. The maximum permissible yield from an adjusted $F_{40\%}$ strategy is 21,300 mt. In contrast to a yield of 17,300 mt, the $F_{40\%}$ yield has a high probability (>0.99 , decision analysis) of decreasing the 2006 spawning biomass below 2002 spawning biomass and a substantial probability (0.18) of decreasing 2006 spawning biomass below 90% of 2002 spawning biomass. The Plan Team concurred with the authors' recommendation of ABC of 17,300 mt for the combined stock in 2002, a yield likely to maintain spawning biomass, and a yield slightly higher than the 2001 ABC of 16,900 (2% increase). The Teams noted that the adjustment below the maximum permissible ABC value is appropriate based on general model uncertainties and the current low level of stock biomass. However, the Team noted that the approach for recommending ABC has changed over time and is likely to change in the future (e.g., previous "decision analyses" were relative to historical low stock levels rather than current stock levels as a reference point).

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{30\%}$ existed for this stock, and that this stock therefore qualified for management under Tier 3 of the BSAI Groundfish FMP. The updated estimate of $B_{40\%}$ from the present assessment is 221,000 (combined across the EBS, AI, and GOA). Projected spawning biomass (combined areas) for 2002 is 193,000, placing sablefish in sub-tier "b" of Tier 3. The maximum permissible $F_{ABC} = F_{40\% \text{ adjusted}}$ is 0.115 which translates to a yield of 21,300 mt for the combined areas (EBS, AI, and the GOA). The Plan Team's recommended 2002 ABC is 17,300 mt and corresponds to $F = 0.09$. A 5-year exponential weighting of longline survey and longline fishery relative abundance may be used to apportion the combined 2002 ABC among regions, resulting in the following values: EBS--1,930 mt, AI--2,550, and GOA--12,820.

The OFL fishing mortality rate is 0.14 which translates into a 2002 OFL (combined areas) of 26,100 mt. Using the abundance-based apportionment scheme described above, 2002 OFL also may be apportioned among regions and results in the following values: EBS--2,900 mt, AI--3,850 mt, and GOA--19,350 mt. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Further apportionment within the GOA areas (with 5% of the Southeast Outside quota re-allocated to the West Yakutat area for trawl-bycatch concerns) gives:

Western:	2,240
Central:	5,430
West Yakutat:	1,940
Southeast Outside:	<u>3,210</u>
Total:	12,820

SLOPE ROCKFISH

		EXPLOITABLE		
		<u>ABC</u>	<u>BIOMASS</u>	<u>CATCH</u> ¹
2000	Pacific ocean perch	13,020	200,310	10,157
	shortraker/rougheye	1,730	70,890	1,745
	northern rockfish	5,120	85,360	3,325
	other slope rockfish	<u>4,900</u>	<u>102,510</u>	<u>577</u>
	TOTAL	24,770	459,070	15,804
2001	Pacific ocean perch	13,510	211,160	11,028
	shortraker/rougheye	1,730	70,890	1,925
	northern rockfish	4,880	93,850	3,126
	other slope rockfish	<u>4,900</u>	<u>102,510</u>	<u>570</u>
	TOTAL	25,020	478,410	16,649
2002	Pacific ocean perch	13,190	293,240	
	shortraker/rougheye	1,610	66,830	
	northern rockfish	4,980	94,350	
	other slope rockfish	<u>5,040</u>	<u>107,960</u>	
	TOTAL	24,820	562,380	

¹ Catch through November 3, 2001.

Results of bottom trawl surveys are important components of the stock assessment for slope rockfish. Because the eastern Gulf of Alaska was not sampled in 2001, substitute estimates of slope rockfish biomass for this region were computed. The authors considered two basic approaches to estimate these substitute biomass values: a value based on a correspondence with past biomass trends in the western and central Gulf, or a value based only on past eastern Gulf survey estimates. The first approach assumes that there is a proportional relationship between the abundance in each area, that the changes are measured by the trawl survey, and that the abundance in the eastern Gulf can be predicted by the proportional relationship. The second approach makes none of these assumptions, but assumes only that the average of past survey results is a reasonable value to use for 2001. The two approaches were compared for four major species of rockfish (Pacific ocean perch, and shortraker, rougheye, and dusky rockfish) by attempting to predict past eastern Gulf survey results using prior information on all areas for the first approach and using only prior information for the eastern Gulf for the second approach. Neither approach was consistently better than the other. Rather than use a different method for the various species, the authors used the consistent, simple approach of averaging of the three most recent biomass estimates for the eastern Gulf from the 1993, 1996, and 1999 surveys to compute biomass estimates for this region in 2001. The Plan Team agreed with this approach.

PACIFIC OCEAN PERCH

The model for Pacific ocean perch is a rockfish model template developed in a modeling workshop model using AD Model Builder software. Previously the stock assessment was based on an age-structured model

using stock synthesis. The rockfish model template is a modification of the northern rockfish model used in last year's assessment. The template is a simple age-structured model with allowance for size composition data that is adaptable to several rockfish species. For ease in interpretation and to make the assessment amenable to the template not all data previously used in the stock synthesis model were used. Excluded data were generally older and of uncertain reliability. Both survey and fishery selectivity patterns were assumed to be constant over time. Inclusion of fewer data sets and constraints on selectivity enabled easier exploration of model behavior and sensitivity. New data included updated catch, the 2001 survey biomass estimate, and fishery age composition from 2000. This is the first time that fishery age composition data have been used.

For the base model survey and fishery selectivity patterns were assumed to be asymptotic and all likelihood components were given an emphasis weight of 1. Several alternate model configurations were investigated. Maximum allowable ABCs from these alternative models ranged 10,860 - 17,770 mt. The Team evaluated the base model ABC (13,190 mt), proposed models 2-5 (10,860 - 17,700 mt), rolling over last year's ABC (13,510 mt), and a projection from last year's assessment with updated catch (14,270 mt). The Team agreed with the author that the base model should be used for the 2002 fishery. The authors stressed that several refinements to the model are expected to be made next year. In particular, the discordance of fishery size data with other data components and the poor fit to age composition and survey biomass estimates needs to be resolved. The base model which represents the default model configuration is a reasonable interim strategy. The ABC is similar to last year's ABC of 13,510, and the model used new data (i.e., updated catch, 2001 trawl survey estimates, and 2000 fishery age compositions). The authors also pointed out that two of the alternative model configurations gave ABCs nearly identical to the ABC from the base model.

Tier 3a is used to compute ABC and OFL. The current female spawning biomass ($B_{2002} = 107,070$ mt) is greater than $B_{40\%}$ (98,790), where $B_{40\%}$ is determined from the average recruitment of the 1977-93 year classes. The estimate of $F_{40\%}$ is 0.050. Applying Tier 3a results in $F_{ABC} \leq 0.050$ and an $ABC \leq 13,190$ mt. The Team recommends that the ABC for Pacific ocean perch for the 2002 fishery in the Gulf of Alaska be set at 13,190 mt. The overfishing level based on Tier 3a ($F_{35\%} = 0.059$) is 15,670 mt.

The Team and the authors concurred with the method of apportionment used in the past. This results in weightings of 4:6:9 for the 1996, and 1999, and 2001 surveys, respectively and area apportionments of 19.8% for the Western area, 62.3% for the Central area, and 17.9% for the Eastern area. This results in recommended ABCs of 2,610 mt for the Western area, 8,220 mt for the Central area, and 2,360 mt for the Eastern area. For Pacific ocean perch the overfishing level is apportioned by area. Using the same apportionment as used for ABC, results in overfishing levels by area of 3,110 mt in the Western area, 9,760 mt in the Central area, and 2,800 mt in the Eastern area.

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. Since Pacific ocean perch are caught exclusively with trawl gear, there is concern that the entire Eastern area TAC might be taken in the area that will remain open to trawling (WYAK). Thus, as done last year, the Team recommends that a separate ABC be set for Pacific ocean perch in WYAK. Using the same weighted average method as described above results in a point estimate of 0.22 for the proportion of the exploitable biomass in the Eastern area that occurs in WYAK. However, there is considerable uncertainty in this estimate. In an effort to balance this uncertainty with associated costs to the industry, the Team recommends that apportionments to West Yakutat be based proportionately on the upper 95% confidence limit of 0.33. This corresponds to an ABC of 780 mt for WYAK. Under this apportionment strategy, very little of the 1,580 mt assigned to the remaining Eastern area (EYAK/SEO) is expected to be harvested. Note that the combined ABC for the WYAK and EYAK/SEO should not exceed 2,360 mt.

SHORTRAKER/ROUGHEYE

As in the past, the average of the exploitable biomasses in the three most recent surveys (1996, 1999, and 2001) is used to determine current exploitable biomass. The current estimates of exploitable biomass are 25,490 mt for shortraker rockfish and 41,360 mt for roughey rockfish. Applying the definitions for ABC and OFL places shortraker rockfish in Tier 5 where $F_{ABC} \leq 0.75M$. Thus, the recommended F_{ABC} for shortraker rockfish is 0.023 (i.e., 0.75×0.03). Applying Tier 4 to roughey rockfish (i.e., $F_{ABC} \leq F_{40\%}$) allows an $F_{ABC} = M = 0.025$ which is less than $F_{40\%} = 0.032$. Applying these F_{ABC} rates to the estimates of exploitable biomass results in ABCs of 586 mt for shortraker rockfish and 1,034 mt for roughey rockfish and a total ABC for the subgroup of 1,620 mt. Overfishing is defined to occur at the harvest rate set equal to $F_{35\%}$ of 0.038 for roughey rockfish and at the $F=M$ rate of 0.030 for shortraker rockfish because data are not available to determine $F_{35\%}$ for shortraker rockfish. These harvest rates are applied to estimates of current exploitable biomass to yield an overfishing limit of 2,340 mt for the shortraker/roughey assemblage.

As in last year's assessment, the Team recommends that the same ABC apportionment methodology used for Pacific ocean perch be applied to shortraker and roughey rockfish. This method results in ABCs of 220 mt for the Western area, 840 mt for the Central area and 560 mt for the Eastern area. The Team did not split the Eastern area ABC into subareas defined by the 140° W longitude boundary in Amendment 41 because this bycatch-only fishery is harvested by both longline and trawl gear.

NORTHERN ROCKFISH

As done last year, the stock assessment for northern rockfish is based on an age-structured model constructed using AD Model Builder software. New data added for this assessment included the 2001 survey biomass estimate, 2001 fishery catch, and fishery age compositions for 1998 and 1999. This is the first time that fishery age compositions have been available for use in the stock assessment.

Five variations of the northern rockfish model were evaluated for this year's assessment. The five models represent changes made to last year's northern rockfish assessment model during development of an age-structured rockfish model template. The differences in the model are basically reformulations of how specific parameters are estimated. Reformulation of survey catchability and selectivity affected results. The Plan Team agreed with the author that more exploratory model runs are needed before such a model can be used for ABC calculations. Consequently, Model 2 is recommended for this year's assessment. Model 2 is last year's northern rockfish assessment model with the addition of fishery age compositions, 2001 survey biomass, and updated catch.

Tier 3a is used to compute ABC and OFL. Current female spawning biomass ($B_{2002} = 40,070$ mt) is greater than $B_{40\%}$ (23,330 mt), where $B_{40\%}$ is determined from the average recruitment of the 1977-94 year classes. The current estimate of $F_{40\%}$ is 0.056. Applying Tier 3a results in $F_{ABC} \leq 0.055$ and an $ABC \leq 4,980$ mt. The Team recommends that the ABC for northern rockfish for the 2002 fishery in the Gulf of Alaska be set at 4,980 mt. The overfishing level based on Tier 3a ($F_{35\%} = 0.067$) is 5,910 mt. In view of recent weak recruitment estimates, the Team noted that harvest projections are likely to decline in the near term.

Apportioning the ABC based on the same method used for Pacific ocean perch results in ABCs of 810 mt in the Western area and 4,170 mt in the Central area. Northern rockfish are combined with other slope rockfish in the Eastern area.

OTHER SLOPE ROCKFISH

Exploitable biomass is determined from the average of the three most recent trawl surveys. Applying the definitions for ABC and OFL places sharpchin rockfish in Tier 4 where $F_{ABC} \leq F_{40\%}$, and the other species of other slope rockfish in Tier 5 where $F_{ABC} \leq 0.75M$. For sharpchin rockfish, the recommended F_{ABC} is $F = M = 0.05$ which is less than the maximum allowable $F_{40\%} = 0.055$. This results in a recommended combined ABC for other slope rockfish of 5,040 mt. Distributing this ABC based on the same method used for Pacific ocean perch results in ABCs of 90 mt in the Western area, 550 mt in the Central area, and 4,400 mt in the Eastern area. Overfishing is defined as $F_{35\%} = 0.064$ for sharpchin rockfish and $F=M$ for the other species. This results in an OFL of 6,610 mt.

The Team recommends that a separate ABC be set for other slope rockfish in the West Yakutat area. Using the same weighted average method as used for Pacific ocean perch results in a point estimate of 0.06 for the proportion of the exploitable biomass in the Eastern area that occurs in West Yakutat. Because a small portion of the Eastern ABC of other slope rockfish has been taken recently and some other slope rockfish are caught with longline gear, the Team recommended that this point estimate be used to apportion the ABC. This corresponds to an ABC of 260 mt in West Yakutat and 4,140 mt in the remaining Eastern area.

	Western	Central	Eastern	West Yakutat	EYAK/SE	Total
Pacific ocean perch	2,610	8,220		780	1,580	13,190
Northern rockfish	810	4,170	0			4,980
Shortraker/rougheye	220	840	560			1,620
Other slope rockfish	90	550		260	4,140	5,040

PELAGIC SHELF ROCKFISH

	EXPLOITABLE		
<u>YEAR</u>	<u>ABC</u>	<u>BIOMASS</u>	<u>CATCH</u> ¹
2000	4,880	54,220	4,657
2001	5,980	66,440	3,008
2002	5,490	62,489	

¹ Catch through November 15, 2001.

The pelagic shelf rockfish (PSR) assemblage is comprised of dusky, yellowtail, and widow rockfishes. Biomass estimates for PSR indicate that dusky rockfish comprise nearly all the biomass. Based on mean trawl survey data in 1996, 1999, and 2001, the 2002 exploitable biomass for the assemblage was calculated to be 62,489 mt. For the first time, computations of ABC and overfishing were done separately for dusky rockfish versus widow and yellowtail rockfish. Previously the species were lumped together in the computations and treated as Tier 4 species. Dusky rockfish, the major component of the assemblage is in Tier 4, and widow and yellowtail are considered to be in Tier 5. An $F=M$ strategy equal to 0.09 for dusky rockfish resulted in an ABC of 5,070 mt for dusky rockfish. This strategy is more conservative than the Tier 4 maximum $F_{40\%}$ of 0.11, and the Team feels a reduction is justified due to concern over the reliability of biomass estimates for this assemblage. The Team continues to encourage the authors to develop an age-structured assessment for dusky rockfish based on data that has become available in recent years. ABCs for widow and yellowtail

rockfish were computed based upon the maximum allowable F for Tier 5 species ($0.75 \times M$), resulting in an ABC of 415 mt. The total recommended Gulfwide ABC for the assemblage in 2002 is 5,490. Given the rationale described for Pacific ocean perch, a respective weighting of 4:6:9 applied to PSR geographical distributions from the 1996, 1999, and 2000 surveys results in ABC apportionment of 510 mt to the Western, 3,480 mt to the Central, and 1,500 mt to the Eastern areas.

The Team recommends that the Eastern area ABC be apportioned to West Yakutat according to the upper 95% confidence limit estimate of proportion in West Yakutat from the three most recent survey years with total Eastern area ABC not to exceed 1,500 mt. Point estimates for West Yakutat and SEO are 640 and 860 respectively. The updated point estimate of F_{OFL} under the Amendment 56 overfishing definitions is $F_{35\%}$ (0.136) producing a gulfwide overfishing level of 8,220 mt.

<u>Western</u>	<u>Central</u>	<u>West Yakutat</u>	<u>SEO</u>	<u>Total</u>
510	3,480	640	860	5,490

DEMERSAL SHELF ROCKFISH

EXPLOITABLE			
<u>YEAR</u>	<u>ABC</u>	<u>BIOMASS</u>	<u>CATCH</u> ¹
2000	340	15,100	381
2001	330	14,695	279
2002	350	15,615	

¹ Catch through November 15, 2001.

Demersal Shelf Rockfish (DSR) is comprised of 7 species of rockfishes, of which yelloweye is the commercial fishery target species. A submersible is used to conduct line transects to estimate yelloweye density. Adult yelloweye biomass is estimated for each management area as the product of density, mean weight, and areal estimates of DSR habitat. The sum of the lower 90% CI (log-based) for each area is used as the best estimate of biomass because the fish are assessed on an area-specific basis for both density and weight.

Revisions to the DSR stock assessment from last year include inclusion of the 2000 average weight data and associated standard error, 2000 fishery age data, updated catch data and the 2001 survey estimate of density for the NSEO area. Using these data and the 1999 survey data from the other areas, the 2002 exploitable biomass estimate for yelloweye rockfish in Southeast/East Yakutat, is 15,615 mt. This is an increase of 6% compared to last year. Using tier 4 and adjusting for the 10% of other species landed in the assemblage, the F_{ABC} was set at $F=M=0.02$, yielding an ABC of 350 mt. This is more conservative than the $F_{40\%}$ level. The overfishing level was set at $F_{35\%}=0.0279 = 480$ mt.

The Plan Team encourages the Regional NMFS to move forward with the DSR full retention amendment, the intent of which is to provide managers with better total bycatch data. It is currently difficult to estimate DSR mortality associated with the halibut fishery. IPHC survey data indicates that there is not a linear relationship between amount of halibut caught and amount of DSR bycatch. In 2002, for the first time, a portion of the directed fishery for DSR will be preempted by the halibut fishery.

THORNYHEAD ROCKFISH

<u>YEAR</u>	<u>EXPLOITABLE</u>		<u>CATCH</u> ¹
	<u>ABC</u>	<u>BIOMASS</u>	
2000	2,360	52,950	1,307
2001	2,310	52,100	1,323
2002	1,990	77,840	

¹ Catch through November 15, 2001.

The updated model incorporated new catch data, biomass estimates from the 2001 trawl survey and relative population numbers from the 2001 sablefish longline survey. Current assessment evaluated several models that looked at different estimates of natural mortality and growth. Based on an evaluation on how alternatives fit the data the authors selected baseline model configuration. However, this model resulted in natural mortality that seems too high.

The Plan Team preferred an alternative model that assumed a natural mortality (0.038). This rate is reasonable compared to other similar species. The Plan Team recommends further model development and data evaluation.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock and stock status relative to $B_{40\%}$ qualified the stock for management under Tier 3a of the GOA Groundfish FMP. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 77,840 t, 0.035, and 0.042, respectively. The area specific apportionments are 360, 835 and 795 mt to the Western, Central and Eastern areas respectively. The overfishing level was determined to be 2,330 mt.

ATKA MACKEREL

<u>YEAR</u>	<u>ABC</u>	<u>CATCH</u> ¹
2000	600	170
2001	600	77
2002	600	

¹Catch through November 15, 2001.

Prior to 1997, exploitable biomass and ABC for Atka mackerel were based on triennial bottom trawl survey estimates. However, schooling behavior, patchy distribution, and habitat preference makes this species difficult to sample with standard trawl survey gear. Atka mackerel are also poor targets for hydroacoustic surveys because they lack swim bladders. Reevaluation of historical survey data indicated abundance estimates prior to 1997 were also compromised by high variability. Thus, existing GOA bottom trawl survey data has limited utility for either absolute abundance estimates or indices for Atka mackerel.

The Plan Team supports a bycatch only fishery as a conservative harvest policy for Atka mackerel because: (1) there is no reliable biomass estimate; (2) localized depletion may occur; and (3) this species has previously exhibited a particular vulnerability to fishing pressure in the GOA. The Team recommends an ABC of 600 mt in 2002 to satisfy bycatch needs in other fisheries. Under Tier 6 criteria, the overfishing level is equal to 6,200 mt, the average catch for 1978-1995.

OVERVIEW OF APPENDICES

Appendix A: Pacific Halibut Stock Assessment and Fishery Evaluation

A separate SAFE report on the Pacific halibut (*Hippoglossus stenolepis*) resource and fishery has been prepared by the staff of the International Pacific Halibut Commission (IPHC) and is included in this SAFE report as Appendix A.

The Teams reviewed the IPHC report during their November meeting. Commercial catches decreased 9% in 2000 over 1999 as did estimates of fishery discards and bycatch mortality. Increases occurred in the sport fishery and in personal use.

The most recent assessment was conducted by IPHC in the fall of 2000. Using an age- and length-structured model which incorporates fishery and survey data, individual assessments were done for IPHC Areas 2A/B, 2C, and 3A. Assessments of Area 3B and 4 were precluded by low exploitation of the stocks in those areas.

Total coastwide exploitable biomass estimates remain high, however, totaling 331,900 mt (round weight) (549 million pounds, net weight) in 2001. Overall setline CEY (Constant Exploitation Yield) was still very high at 57,300 mt (round weight) (94.7 million pounds net weight).

The assessment also showed that the 1987 year class is strong, with subsequent year classes not as strong, although those age classes were estimated imprecisely in 1999. Overall, recruitment remains low in all areas according to IPHC setline survey results. However, NMFS trawl survey data suggest that juvenile halibut abundance may not be as low as the surveys indicate.

Appendix B: Pacific Halibut Discard Mortality Rates

The report by IPHC staff on the results of analyses of 2000 observer data examining halibut discard mortality rates (DMRs) is included as Appendix B. The report was reviewed in a joint session of the Plan Teams during the November meeting. Following the plan adopted in 2000, halibut bycatch mortality in open access fisheries is managed using a long-term average DMR. IPHC made no recommendations for changes in 2002 from the DMRs used in 2001. The Teams endorse the IPHC recommendations for the CDQ fisheries.

The IPHC recommendations are included in the summary table below. The recommended Preseason Assumed DMRs are based on an average of fishery DMRs during 1990-1999, with the exception of the BSAI hook-&-line fishery for Pacific cod which is based on an average of 1996-1999.

Data for CDQ fisheries were collected in 2000; hook-&-line fishing was directed towards Pacific cod and turbot. Pollock, flathead sole, and atka mackerel were targeted by trawls. Pot vessels targeted on cod and sablefish. The DMRs calculated for 2000 for those fisheries were carried forward as recommendations for monitoring in 2002 CDQ targets. The analysis recommends monitoring bycatch mortality in other CDQ targets using the open access DMRs.

Appendix C: Prohibited Species Catch Summary for Halibut

Information on halibut bycatch in the groundfish fisheries conducted in the Gulf of Alaska (GOA) is provided in Appendix C. It is intended for use by the Council in its utilization of the halibut species bycatch framework measures.

The PSC limits for halibut in the Gulf of Alaska are set by gear type and apportioned seasonally over the fishing year (Amendment 21). For 2001 the Council recommended the following halibut PSC apportionments for the Gulf of Alaska groundfish fisheries:

2001 Trawl			2001 Hook and Line		
1st quarter	Jan 1 - Apr 1	550 mt (28%)	1st trimester	Jan 1 - May 17	205 mt (70%)
2nd quarter	Apr 1 - Jul 10	450 mt (22%)	2nd trimester	May 17 - Aug 31	any rollover
3rd quarter	Jul 1 - Oct 1	700 mt (35%)	3rd trimester	Aug 31 - Dec 31	85 mt (30%)
4th quarter	Oct 1 - Dec 31	300 mt (15%)	DSR	Jan 1 - Dec 31	10 mt
TOTAL		2,000 mt	300 mt		

Bycatch mortality of Pacific halibut in the 2001 Gulf of Alaska groundfish fisheries totaled 2,492 mt for trawl and hook-and-line fisheries through November 10, 2001. Halibut mortality was 2,203 from trawl gear and 285 mt for hook-and-line gear, and 4 mt for pot gear.

Appendix D: Echo Intergration-Trawl Survey Results for Walleye Pollock in the Gulf of Alaska during 2009

Since 1980, scientists from the Midwater Assessment and Conservation Engineering group at the Alaska Fisheries Science Center (AFSC), Seattle, WA, have conducted annual echo integration-trawl (EIT) surveys (except in 1982 and 1999) in the Gulf of Alaska to assess the distribution and abundance of walleye pollock (*Theragra chalcogramma*), hereafter referred to as pollock. The surveys focused primarily on pre-spawning pollock in the Shelikof Strait area. Results from surveys outside of Shelikof Strait generally did not indicate large amounts of pollock, although these efforts were quite restrictive both temporally and spatially (Williamson 1989, Karp 1990, and references therein). The only substantial pre-spawning aggregations of pollock found outside of Shelikof Strait were detected in 1994-96 during surveys of the Shumagin Islands (Wilson 1994, Wilson et al. 1995, Wilson et al. 1996). Only the Shelikof Strait area has been surveyed since 1997. The primary objectives of the most recent survey were to determine abundance estimates as well as various biological characteristics of pollock. This survey (AFSC cruise number is MF2000-04) was conducted during late winter/early spring 2000.

Appendix E: Definitions of Common Acronyms

A collection of acronym definitions used in the SAFE has been included as Appendix E.

Table 1

Table 2

Table 3. Summary of fishing mortality rates and overfishing levels for the Gulf of Alaska, 2002.

Species	Tier	F_{ABC}^1	Strategy	F_{OFL}^2	Strategy
Pollock	3b	0.17	F_{ABC}	0.24	$F_{35\%}$ adjusted
Pacific cod	3b	0.34	F_{ABC}	0.39	$F_{35\%}$ adjusted
Deepwater flatfish	5,6 ³	0.075	F_{ABC}^3	NA	F_{OFL}^4
Rex sole	5	0.15	$F=0.75M$	0.20	$F=M$
Flathead sole	5	0.15	$F=0.75M$	0.20	$F=M$
Shallow water flatfish	4,5 ⁵	0.15-0.17	$F=0.75M$, $F_{40\%}^5$	0.20-0.21	$F_{35\%}$, $F=M^6$
Arrowtooth	3a	0.134	$F_{40\%}$	0.159	$F_{35\%}$
Sablefish	3b	0.093	F_{ABC}	0.143	$F_{35\%}$ adjusted
Pacific ocean perch	3a	0.050	$F_{40\%}$	0.059	$F_{35\%}$
Shortraker/rougheye	4,5 ⁷	0.023/0.025	$F=.75M$, $F=M^7$	0.03/.038	$F=M$, $F_{35\%}^8$
Rockfish (other slope)	4,5 ⁹	0.03-0.75	$F=.75M$, $F=M^9$	0.04-0.10	$F_{35\%}$, $F=M^{10}$
Northern rockfish	3a	0.056	$F_{40\%}$	0.067	$F_{35\%}$
Pelagic Shelf Rockfish	4,5 ¹¹	0.09	$F=.75M$, $F=M^{11}$	0.09-0.136	$F_{35\%}$, $F=M^{12}$
Demersal Shelf Rockfish	4	0.02	$F=M$	0.028	$F_{35\%}$
Thornyhead rockfish	3a	0.035	$F_{40\%}$	0.042	$F_{35\%}$
Atka mackerel	6	NA	F_{ABC}^{13}	NA	F_{OFL}^{14}

- 1/ Fishing mortality rate corresponding to acceptable biological catch.
2/ Maximum fishing mortality rate allowable under overfishing definition.
3/ $F_{ABC}=.75M$ for Dover sole (Tier 5), $ABC=.75 \times$ average catch (1978-1995) for other deepwater flatfish (Tier 6).
4/ $F=M$ for Dover sole, average catch (1978-1995) for other deepwater flatfish.
5/ $F_{40\%}$ for rocksole (Tier 4), $F=.75M$ for remaining shallowwater flatfish (Tier 5).
6/ $F=M$ for sharpchin rockfish (Tier 4), $F=.75M$ for other species (Tier 5).
7/ $F=.75M$ for shortraker (Tier 5), $F=M$ for rougheye (Tier 4).
8/ $F=M$ for shortraker, $F_{35\%}$ for rougheye.
9/ $F=M$ for sharpchin rockfish (Tier 4), $F=.75M$ for other species (Tier 5).
10/ $F_{35\%}$ for sharpchin, $F=M$ for other species.
11/ $F=M$ for dusky rockfish (Tier 4), $F=.75M$ for widow and yellowtail rockfish (Tier 5).
12/ $F_{35\%}$ for dusky rockfish, $F=M$ for widow and yellowtail rockfish.
13/ ABC for Atka mackerel is 600 mt for bycatch in other target fisheries.
14/ OFL for Atka mackerel is equal to average catch from 1978 to 1995.

Table 4. Maximum permissible fishing mortality rates and ABCs as defined in Amendment 56 to the GOA and BSAI Groundfish FMPs, and the 2002 Plan Team recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum.

Gulf of Alaska

Species	Tier	2002	2002	2002	2002
		Max. Permissible F_{ABC}	Max. Permissible ABC	F_{ABC}	ABC
Pollock	3b	0.20	64,110	0.17	53,490
Pacific cod	3b	0.39	65,200	0.34	57,600
Sablefish	3b	0.115	15,760	0.093	12,820
Rougheye rockfish	4	0.032	1,320	0.025	1,030
Shortraker rockfish	5	0.023	590	0.023	590
Total Shortraker/Rougheye	4,5		1,910		1,620
Other slope rockfish (sharpchin)	4	0.053	2,110	0.050	1,990
Other slope rockfish (redstripe)	5	0.075	1,020	0.075	1,020
Other slope rockfish (harlequin)	5	0.045	660	0.045	660
Other slope rockfish (silvergrey)	5	0.030	850	0.030	850
Other slope rockfish (redbanded)	5	0.045	330	0.045	330
Other slope rockfish (minor species)	5	0.045	190	0.045	190
Total other slope rockfish	4,5		5160		5,040
Dusky rockfish	4	0.110	6,200	0.090	5,070
Widow and Yellowtail rockfish	5	0.068	420	0.068	420
Total Pelagic shelf rockfish	4,5		6,620		5,490
Demersal shelf rockfish	4	0.025	430	0.020	350
Atka mackerel	6	NA	4,700	NA	600

Table 5

Figure 1